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ABSTRACT

The purpose of this empirical study was to establish initial reliability and validity data for a new Television Test of Science Processes (TTSP) which was developed in conjunction with the Science for the Seventies project of televised science instruction modules. Reliability was determined through internal consistency analysis using the Kuder-Richardson Formula 20. The findings indicate that teachers and administrators needing to assess science progress, especially from curricula emphasizing science process instruction, should find the TTSP useful. Three sample questions are appended. (Author/STS)

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RELIABILITY AND VALIDITY OF A NEW TELEVISION TEST OF SCIENCE PROCESSES

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IR004910

Purpose and Rationale

The purpose of this empirical study was to establish initial reliability and validity data for a new Television Test of Science Processes (TTSP). In 1968, The Pennsylvania Department of Education began to assist elementary teachers in a transition to a new science program called Science for the Seventies (Pennsylvania Department of Education, 1971). An integral part of the Science for the Seventies curricular material is a series of ten fifteen-minute televised programs for primary grade students and ten twenty-minute programs for intermediate level students.

Collateral with the televised instruction, the Science for the Seventies project constructed and field tested a television test to assess the impact of the instructional material (Torrence, 1976). The data presented here represents the beginning effort to provide reliability and validity information on the Television Test of Science Processes.

Procedures

Test Development

The present Television Test of Science Processes was adapted from Tannenbaum's (1968) Test of Science Processes (TSP). The TSP was adapted for the present project rather than used directly because it had originally been developed for junior high school students and was presented in a 35 mm slide format. The Tannenbaum test had 96 items.

There were three phases or forms of the present TTSP. The first form (TTSP - Form A) of the TTSP included 68 items judged by experts to be content valid for Science for the Seventies assessment at the fifth and sixth grade levels. These were selected and revised from Tannenbaum's original 96 items.

The television production consisted of directly videotaping the visuals (stimulus cues for test items) rather than to use the 2 X 2 slides through the TV multiplexer system. TTSP - Form A was taped with script allowing 90 seconds response time for each of the 68 items. TTSP - Form B was produced after actual item response time data were gathered on a sample of fifth grade students using TTSP - Form A. Response time allowances on Form B ranged from 16 to 58 seconds and were based on 90th percentile values of time actually taken, per item, during Form A administration. TTSP - Form B was then field testing with both fifth and sixth grade students. From Form B field testing, using criteria of item difficulty ranging from .35 to .85 and positive item - total test score point biserial correlations, a final 40 item TTSP - Form C was produced. This new videotape and auxillary test administration procedure materials were used in the norming reliability and validation data gathering phase of the TTSP project.

Sample

The sample in the large norming reliability study using Form C of the TTSP consisted of 3480 fifth grade students in Pennsylvania drawn from 12 different counties and 19 different school systems. Both public and Catholic, and rural and urban schools were included in the sampling plan. The initial validation data were collected on an additional sample of 207 fifth and sixth grade students.

Data Collected

During October, 1975 the fifth grade norming sample was given the TTSP - Form C under normal classroom conditions of television viewing and test taking. Administration is accomplished in two one-half hour program tapes. Broadcast was done over WPSX-TV, Channel 3 of the Pennsylvania Public Television

Network in cooperation with the Allegheny Educational Broadcast Council. Only basic TTSP - Form C data were collected from this norming sample.

For the validation sample of fifth and sixth grade students, the following information was collected: Television Test of Science Processes (TTSP) scores; Test of Science Processes (TSP) scores from Tannenbaum's test; language total and subtest scores for the Comprehensive Test of Basic Skills (CTBS) from McGraw-Hill 1973 including areas of science, math, vocabulary, reading comprehension and social studies; total scores and verbal and non-verbal subtest scores on the Short Form Test of Academic Aptitude (SFTAA) by McGraw-Hill, 1970; and science grades (0-4 scale) on midyear report cards. Correlations of variables with science grades should be viewed essentially as predictive validity coefficients whereas intercorrelations of the test variables should be viewed as concurrent validity coefficients.

Results

Reliability

Reliability was determined through internal consistency analysis using the Kuder-Richardson formula 20. Internal consistency coefficients indicate the extent to which items hang together as a unidimensional scale. For the norming sample of 3480 fifth grade students, the KR_{20} value was .736. Approximately 74% of the observed score variance is estimated to be true score variance. For the validity sample comprised of both fifth and sixth grade students, the KR_{20} value was .816. This larger coefficient can probably be attributed to the greater variability of performance (standard deviation = 6.29 in validity sample versus 5.35 in norming sample) on the TTSP - Form C. It should be noted that Tannenbaum's (1968) cited TSP reliability based on a 96 item length scale was .91. For the present data, if the reliability

coefficients for both the norming and validity samples are adjusted via the Spearman-Brown formula for a test length factor of 2.4 (40 items to 96 items), the new estimates of KR_{20} values would be .87 and .914 respectively. Hence, the reliability of the TTSP - Form C seems, relative to length, comparable to Tannenbaum's original scale.

Validity

Table 1 presents the results of correlating each test variable with mid year science grades. All correlations are significantly different than 0 at the .01 level. The best single prediction of grades was Tannenbaum's TSP and the lowest correlation resulted between grades and the new TTSP. However, all correlations are in the moderate range. Variance common to each predictor with the criterion of grades ranged from 32% to 48%. Table 1 also presents the intercorrelations amongst the test variables. Again, all correlations are significantly different than 0. While the TTSP consistently has somewhat lower intercorrelations, it seems obvious that a strong common core runs through all measures.

Conclusions

The new Television Test of Science Processes has comparable internal consistency reliability to its parent instrument - Tannenbaum's Test of Science Processes. Validity data - both predictive and concurrent - indicates that the TTSP is comparable in predicting fifth and sixth grade science grades and also measures essentially the same characteristics as the other validation instruments. Teachers and school administrators needing to assess science progress - especially from curricula emphasizing science processes instruction, should find the TTSP useful.

References

Comprehensive Tests of Basic Skills, Level 2, Form S. CTB/McGraw-Hill, 1973.

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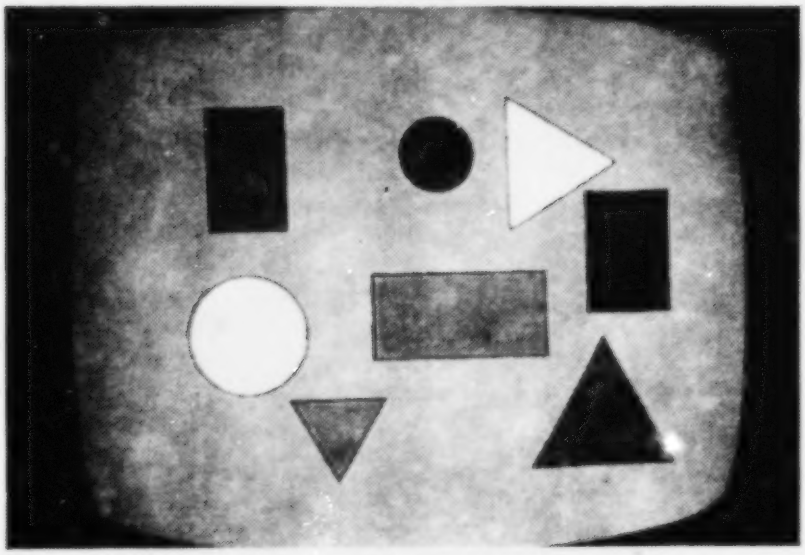
TABLE 1

Intercorrelations of Variables (N=207)

1.	TTSP	1.000	.658	.620	.611	.645	.660	.653	.634	.641	.552	.626	.570
2.	TSP		1.000	.779	.749	.737	.761	.770	.783	.813	.770	.720	.690
3.	CTBS-Voc.			1.000	.850	.822	.775	.753	.819	.842	.864	.653	.646
4.	CTBS. Read C.				1.000	.800	.783	.746	.805	.800	.801	.643	.610
5.	CTBS - La. Tot.					1.000	.737	.792	.791	.796	.774	.665	.642
6.	CTBS - Sci.						1.000	.764	.773	.813	.755	.723	.603
7.	CTBS - Math							1.000	.768	.812	.710	.789	.681
8.	CTBS - Soc S.								1.000	.831	.791	.720	.630
9.	SFTAA - Tot									1.000	.929	.888	.669
10.	SFTAA - V										1.000	.664	.593
11.	SFTAA - NV											1.000	.650
12.	GRADES												1.000

.319 .412

QUESTION 2



VISUAL

2. This is a picture of 8 pieces of paper. If you group them by shape, what is the smallest number of groups you can make?

   A. 1

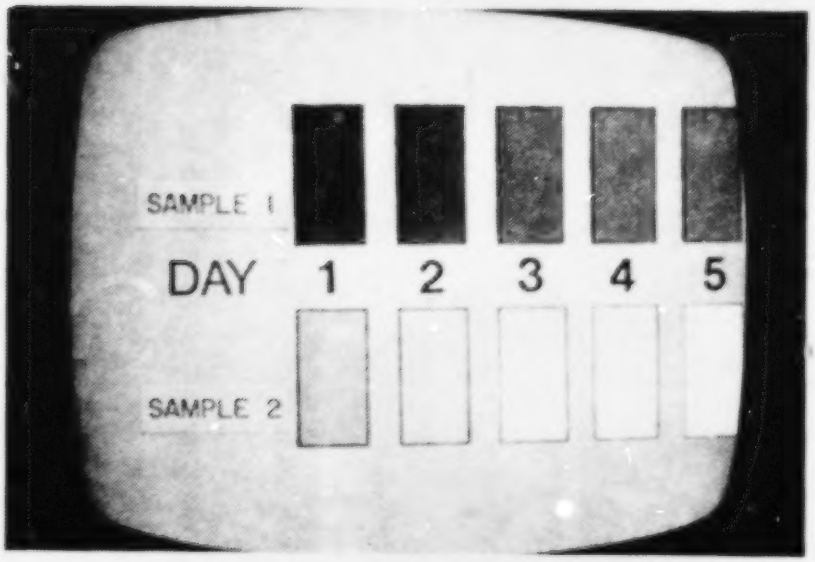
   B. 2

   C. 3

   D. 4

   E. 5

QUESTION 4



VISUAL

4. This is a picture of pieces of paper which were left in the sun for different numbers of days. Which is the only thing you can say for sure, based on what you see in the picture?

   A. Sample 1 faded more than sample 2

   B. All paper will continue to fade forever the longer they are left in the sun

   C. Any paper left in the sun will fade

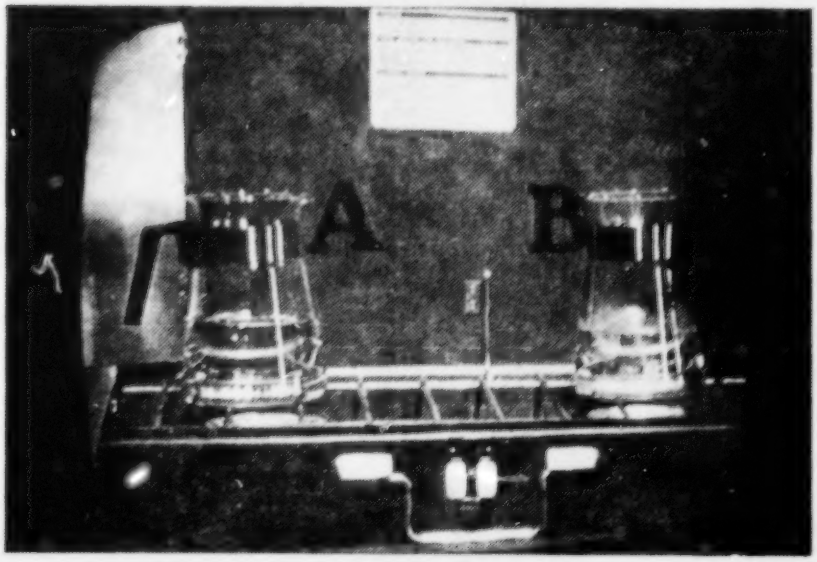
   D. Both samples faded more by day 5 than it had by day 2

   E. Paper will fade in the sun, but cloth will not.

Dif
.536

p.b.s.
.448

QUESTION 6



VISUAL

6. There are two pots of water on a stove. Which choice is the best way of telling how they are different?

   A. The water is boiling in pot B

   B. The gas in on in pot B

   C. The water gets hot when the gas is on

   D. The water is not boiling in pot A

   E. The water is boiling in pot B, but is not boiling in pot A.